HEALTH MAINTENANCE: A STRATEGY FOR PREVENTING CANCER AND HEART DISEASE*

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HEALTH maintenance refers to measures that will enable an individual to stay young and healthy in body and mind for as many years as possible. For much of the world, heart disease and cancer constitute the major obstacles to health. In 1969 the national health survey conducted by the Department of Health, Education, and Welfare (see Table I) found that 3% of the 40.5 million persons aged 45 through 64 years in the United States were chronically disabled because of heart disease. In this same age group, heart disease and cancer were responsible for more than 10 million days spent in hospitals, with costs in excess of one billion dollars. For those more than 65 years of age the disability days and hospital days per 1,000 persons were more than doubled.

Mortality before the age of 65, even more than morbidity, is evidence of the failure of health-maintenance practices. The importance of heart disease and cancer as causes of death is well known; for ready reference, figures from the 1968 Vital Statistics of the United States[3] are given in Table II. It is apparent that after the age of 50 years ischemic heart disease and neoplasms together account for more than half of all reported deaths.

Perhaps we should regard most of the hospitalizations, chronic disability, and deaths from heart disease and cancer occurring before age 65 as unnecessary. Our short-term objectives should be a reduction of 50% in heart-disease and 30% in cancer by the year 2000. How can we achieve this?

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TABLE I. DISABILITY AND HOSPITAL DAYS EXPERIENCED BY THE POPULATION OF THE UNITED STATES IN 1969*

Age group	Population base (thousands)	Disability†		Hospital days (thousands)		
		All causes %	Heart disease %	Cancer	Heart disease	All causes
17	66,939	1.5	0.1	584	192	24,188
17-44	70,526	5.0	0.3	919	1,314	74,102
45-64	40,448	15.6	3.0	3,175	7,201	65,268
65+	18,499	37.1	7.6	3,077	8,506	66,750
Total	196,412	9.1	1.4	7,755	17,214	230,308

*Source: National Health Survey: *Age Patterns in Medical Care, Illness, and Disability, 1968-1969.* Vital and Health Statistics, Series 10, Nos. 70 and 80, Washington, D.C., Dept. HEW, 1973.

†Limited in or unable to carry on major activity.

An aphorism about prevention frequently used by those engaged in industrial medicine and in the control of communicable disease is that "anything that depends on the individual is bound to fail." Thus, most experts believe that a protective shield welded over an emory wheel is superior to goggles and that the elimination of the malaria mosquito is superior to chemoprophylaxis. Unfortunately, in the control of heart disease and cancer the managerial or environmental approach to the control of disease is strictly limited. With our present knowledge, to achieve success in the control of these diseases we must directly influence those who are being protected and require that they take positive action in their own behalf. The development and maintenance of such programs is health maintenance.

The pessimistic view that the modification of behavior is not possible in large groups whose members are not stimulated by personal illness does not appear to reflect the actual situation. In New York today the prevalence of the major risk factors for coronary atherosclerosis—hypercholesterolemia, hypertension, and cigarette smoking—among white males is inversely related to social status. Even among outdoor blue-collar workers, however, the percentage who are cigarette smokers (45%) is much lower than five years ago. These differences reflect the effects of community educational programs on cigarette smoking and dietary habits.

In Table III our findings are given for a random sampling consisting of the first 120 white males screened in March 1974 for risk

TABLE II. DEATHS FROM ISCHEMIC HEART DISEASE AND CANCER IN THE UNITED STATES IN SELECTED AGE GROUPS IN 1968*

Age (years)	*Ischemic heart disease*	*Neoplasms*	*all causes*
10-14	11	1,121	8,467
20-24	132	1,379	21,473
30-34	1,157	2,490	19,194
40-44	9,701	9,527	46,856
50-54	30,695	24,961	99,614
60-64	64,372	41,052	172,217
70-74	100,779	46,153	245,065

*Source: *Vital Statistics of the United States 1968. Mortality, Part B.* Washington, D.C., Govt. Print. Off., 1968, vol. 2.

factors associated with heart disease in each of three different work environments: sanitation workers, repair-shop mechanics, and university faculty members. After excluding persons who were outside the selected age group of 35 to 57 years, the groups contained 113, 114, and 108 persons respectively. The university faculty group was found to have significantly lower average values ($p<.05$) for serum cholesterol, diastolic blood pressure, and number of cigarettes smoked than the two blue-collar groups combined.

Health maintenance might be considered as beginning with genetic advice and family planning. McKusick[4] in the United States and Campbell[5] in the United Kingdom have done much to expand knowledge in this area; a good review has been provided by Emanuel.[6] It has been shown that with one child affected by congenital heart disease in a family, the risk to subsequent children increases from the expected 0.5% to about 3%. With atrial septal defects of the ostium secondum type and atrioventricular defects the hereditary risk may be higher and is evident in offspring of those affected as well as siblings. Congenital heart disease is also associated with other hereditary disorders (e.g., Marfan's syndrome and the Ellis-Van Creveld syndrome), including those associated with abnormal chromosomes such as Down's syndrome and Turner's syndrome. The population involved is small, but for the latter disorders amniocentesis early in pregnancy is advocated by some enthusiasts. Familial type II hyperlipoproteinemia constitutes a more widespread problem. In this syndrome the low density lipoprotein cholesterol is in the upper 5% of the normal range; the heterozygote can have a first degree relative with the disease or with tendon xanthomas.

TABLE III. A COMPARISON OF RISK FACTORS FOR CORONARY ATHEROSCLEROSIS AMONG THREE GROUPS OF WORKING WHITE MALES AGE 35 TO 57 YEARS IN NEW YORK, MARCH 1974

		Average (standard errors in parenthesis)				
*Population**	*Number†*	*Age*	*Cholesterol*	*Diastolic blood pressure*	*Cigarettes‡*	*Smokers (%)*
Sanitation workers	113	46.5 (0.54)	230.7 (3.88)	85.9 (1.04)	13.2 (1.62)	45
Repair shop mechanics	114	49.9 (0.56)	232.0 (4.27)	85.9 (0.89)	6.7 (1.20)	26
University faculty	108	46.5 (0.56)	221.5 (3.94)	81.2 (1.09)	6.4 (1.14)	29
t value [(a + b) vs. c]		**N.S.**	**1.98**	**3.92**	**2.18**	

*A random sample consisting of the first 120 white males appearing at each location.
†Those outside the selected age range were eliminated.
‡Average number smoked per day by entire group.

This condition is transmitted as an autosomal dominant[7] and among males the risk of coronary disease before the age of 50 may be as high as 50%. Still larger numbers are involved when we consider the inheritance of essential hypertension; Miall et al.[8] have advanced strong evidence that this is multifactorially determined. Familial aggregation of blood pressure in childhood has been demonstrated.[9]

Unfortunately, there are few areas where the gap between knowledge and application is broader than in clinical human genetics. Skilled counseling is not widely available and where it is the patients are usually "interesting" problems referred by medical colleagues rather than representative of the problems and needs of the total population. The program in San Diego, Calif.—where primary screening is provided in county clinics by specially trained nurses who refer problem cases to a central unit for skilled genetic counseling—constitutes an exception which could serve as a model for the rest of the nation.

Those with a healthy start must maintain this through childhood. In penicillin we have the potential for almost complete primary or secondary prevention of rheumatic fever; this has been clearly demonstrated with moderate success in a number of communities. Findings by Bergman and Werner[10]—that of a group of children given a 10-day course of oral penicillin only 44% were still taking the drug by the third day—emphasize the need for more than simply making a medical

diagnosis and distributing pills The patient must know why the penicillin is being given and the risks involved in discontinuing therapy. In a secondary prevention program I conducted in Germiston, South Africa, monthly throat swabs were taken from participants in the program and a search made for penicillin-sensitive organisms. The presence of such organisms indicated a failure to take the prescribed oral penicillin. Forty-three positive swabs were found in 3,187 tests, for a failure rate of 1.5%. This gave us an opportunity to warn the patient; repeat infections were in consequence uncommon (the 43 positive swabs came from 35 persons).

Iatrogenically induced disability attributed to heart disease which proved nonexistent is a very real problem. Up to 30% of initial clinical diagnoses of rheumatic fever and congenital heart disease are probably in error and many of the victims of these mistaken diagnoses live an unnecessarily handicapped life thereafter. Health maintenance involves reidentification and reassurance of normality as much as maintaining a watch to prevent the appearance or extension of chronic disease.

Despite occasional recorded successes, most programs[11] attempting to teach schoolchildren to avoid adult social problems (cigarette smoking, dietary excesses, alcoholism, drug usage, etc.) have been failures and many have actually reversed the desired effect. Children do, however, learn by imitating respected elders (imprinting), including their parents. If the parents live a life that we associate today with a reduced risk of coronary disease and cancer (not smoking cigarettes, eating a prudent diet, accepting medical screening and supervision, taking enough exercise) it can be expected that the children will follow the same pattern and probably will benefit more than the parents.

No physician can be expected to know the toxic effects of the 11,000 different chemical substances listed in the 1973 edition of the *Toxic Substances List*[12] or to know which of these are coded CAR for carcinogenic effects or CVS for cardiovascular effects. He can, however, examine the occupations of those persons whose health he is responsible for maintaining and attempt to ascertain whether these expose the workers to any particular risk. For example, in New York City the observation by J. Cimino that sanitation workers were exposed to carbon monoxide from their trucks and hence were having an excessive death rate from coronary artery disease led to the truck exhausts being raised well above the ground. This probably saved more lives

than are saved by several brain surgeons in the course of their lifetimes. At present the coordination at the national level between the Environmental Protection Agency, the National Cancer Institute, and the National Institute of Occupational Safety and Health leaves something to be desired, but a sincere attempt is being made to correct this.

Any program directed at the identification of high-risk populations or those with early forms of disease and attempting to reduce the amount of serious disease experienced by these groups requires four steps:

1) The identification of the high-risk population or the population with early disease in a primary screening.

2) The successful referral of those found at this primary screening to a secondary screening for diagnostic evaluation.

3) The initiation of appropriate therapy.

4) The creation of a system whereby appropriate intervention is maintained and the situation evaluated periodically.

Most attention has been concentrated on steps 1 and 3, but these are unquestionably the easiest. When a truly serious attempt is made—with a preliminary educational program, community acceptance, the use of personnel acceptable to the population at risk, taking the facilities for screening to those being screened, and individualizing the process—more than 90% of a population can be examined. This applies to communicable diseases such as tuberculosis, to identifying risk factors for coronary artery disease, to finding persons with hypertension, and to obtaining Pap smears or breast examinations. This high percentage of persons at risk must be screened to avoid results which suggest that the screen is not achieving anything. For example, it was found that the mortality from cancer of the cervix in British Columbia is, despite intensive screening in that province, only a little lower than in the rest of Canada.[13] This difference may be accounted for by different hysterectomy rates alone, but there are at least two other possible explanations. One is that the type of cervical cancer discovered at the screening may be unrelated to the fatal type. The other, perhaps more likely, explanation is that almost all the deaths from cancer of the cervix both in British Columbia and elsewhere in Canada occur among the small number of females who normally avoid medical examination and medical care.

To intervene on the basis of a risk factor or early in a disease re-

quires that, first, an effective therapy exists and, second, that it does more good than harm. In the first category we are often largely helpless when faced with genetically determined disease. In the second category we have no conclusive evidence that survival can be increased by the treatment of asymptomatic hyperglycemia, ocular hypertension, diastolic blood pressures in the range of 90 to 100, or lung cancer by any chemotherapeutic or surgical modality available. None-the-less, the mechanics of therapeutic intervention are usually fairly simple.

The real difficulties are found with Steps 2 and 4 above. It is only with an extreme effort that it is possible to get more than 70% of those found to be outside the "normal" range at a primary screening to attend the diagnostic evaluation or secondary screening. Fear keeps people away. Maintenance of therapy is even more difficult. Among volunteer populations a drop-out rate of 30% after five years is usual, even in well-controlled studies, while in nonvolunteer populations the drop-out rate in the same period often is twice as large. A drop-out rate of 10% in the first year and 5% in subsequent years represents a very satisfactory goal to aim at. This is, after all, what health maintenance is all about.

A careful watch should be kept on those persons who are on continued long-term therapy to insure that we are not doing them more harm than good. The literature includes many examples of therapies which were continued long after it was obvious that the harm outweighed the benefit. We have no right to assume that returning a high blood pressure or cholesterol level to normal will reduce the risk to the individual concerned to that of a person who always had the lower level. Our drug treatment of hypertension risks increasing the incidence of coronary artery disease, and our treatment for hypercholesterolemia risks may cause other disorders such as premature aging. The beneficial effects reported for giving up smoking actually compare exsmokers to present smokers; these exsmokers may be inherently different. Perhaps giving up smoking slows down mental processes to such a degree that the gain in life expectancy does not justify the loss. The evidence at present strongly suggests that reducing cholesterol, giving up smoking, and treating blood pressures in the range of 95 to 105 are beneficial—but we cannot accept these as proven facts until the results of the present national trials in these areas have been completed and fully evaluated.

Without a program of health education that is meaningful, increased professional knowledge will not modify community behavior. Programs of health education must be relevant to the communities being educated, given by people acceptable to those communities, and associated with the means to carry out any recommendations. Only thus can success be obtained.

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